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# Endogenous Market Structures and Financial Development

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Federal Reserve Bank of Atlanta

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**Abstract:** Existing theories that emphasize the significance of financial intermediation for economic development have not addressed two important empirical facts: (i) the relationship between financial and real activities depends crucially on the stage of development, and (ii) financial and industrial market structures vary widely across otherwise similar countries. To explain these observations, we develop a dynamic general equilibrium model allowing for endogenous market structures in which financial deepening spurs real activity through intermediate product broadening. We show the possibility of multiple steady-state equilibria and characterize how these equilibria respond to various shocks. In particular, we examine the determinants of financial deepening, product broadening, the saving rate, the loan-deposit interest rate spread, and the degree of competitiveness of financial and product markets. We find that the dynamic interactions between financial and real activities depend critically on the synergy of financial and industrial competitiveness.

JEL classification: E44, O41, L16

Key words: financial intermediation, economic development, imperfect competition

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# Endogenous Market Structures and Financial Development

## I. INTRODUCTION

The importance of financial intermediation in determining the level of real economic activity has been known for some time. Walter Bagehot (1915) was the first to emphasize the links between the real and financial sectors, and the crucial nature of these links was further elucidated by Schumpeter (1934) and Knight (1951). In recent years a growing body of empirical work has been devoted to establishing relationships between financial intermediation and economic development. The newer literature has documented two key observations. First, the correlation between financial and real activity depends on the stage of development and may in some cases be negative, which we refer to as “stage-dependent financial development.”<sup>1</sup> Second, the degrees of competitiveness of financial and product markets vary significantly across otherwise similar countries, which we refer to as “heterogenous market structures.”<sup>2</sup> Most of the recent theoretical papers examining the relationship between financial intermediation and economic development have focused on the emergence of financial intermediation in dynamic general-equilibrium models based on the growth-promoting role of such intermediation in overcoming market frictions. While these models have provided significant insights into the relationship between the financial and real sectors,

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<sup>1</sup> Goldsmith (1969) and King and Levine (1993) establish that growth correlates positively with many indicators of financial development using cross-country data, while Jayaratne and Strahan (1996) find that bank branch deregulation spurs growth using cross-state data. However, De Gregorio and Guidotti (1992) and Fernandez and Galetovic (1994) qualify these results and show that the relationship varies with the stage of economic development. More specifically, Fernandez and Galetovic (1994) find that the positive relationship within the OECD countries is much weaker than within non-OECD countries - indeed, such a correlation is nearly absent when Japan is excluded from the OECD sample. For twelve Latin American countries, De Gregorio and Guidotti (1992) conclude that the development of the real and the financial sectors are negatively related using panel data analysis with six-year averages.

<sup>2</sup> Financial market competition has been examined by Shaffer (1995) and Scotese and Wang (1996). Shaffer (1995) estimates the extent of competition in the commercial banking industry for fifteen industrialized countries and finds much variation across countries, with five countries showing statistically significant evidence of market power. Scotese and Wang (1996) suggest different market power may be responsible for cross-country differences in the real effects of financial innovation over the business cycle. For industrial market structure, similar variation is documented, for example, in the twelve-industry, six-country study of Scherer et al. (1975) and in the survey by Caves (1989), however, Schmalensee (1989) argues that there is little variation among industrialized countries.

they are unable to address the aforementioned empirical facts. To explain these important observations, we develop the idea that financial deepening (or increases in the ratio of intermediated loans to output) spurs real activity through production specialization (or uses of more sophisticated intermediate goods production processes) with a special emphasis on an active role for financial and industrial market structures.

Economies where market structures are endogenous typically exhibit multiple equilibria which is the basis for explaining both empirical regularities mentioned above.

Recent theoretical work of financial intermediation and economic development has examined various roles played by the financial sector to justify the emergence of financial intermediaries.<sup>3</sup> For instance, Diamond and Dybvig (1983) and Bencivenga and Smith (1991) stress the liquidity management role of banks: by converting liquid funds into longer term investments, financial intermediation improves the performance of the real sector. Williamson (1986a) and Greenwood and Jovanovic (1990) highlight the risk pooling and monitoring functions of financial intermediaries: by pooling savings for diversified investment projects and monitoring the behavior of the borrowing firms, banks ensure higher expected rates of returns. One common theme of these papers is that financial intermediaries provide access to the benefits of pooled funds and economies of scale.<sup>4</sup> We take up this theme and assume financial intermediaries' primary role is to pool household funds that are directly loaned to producers, because individuals

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<sup>3</sup> As originally illuminated by Gurley and Shaw (1960) financial intermediaries exist to transform securities issued by firms into securities that have desirable characteristics for final savers. As Fama (1980) pointed out, when the financial sector is perfectly competitive and there are no frictions, intermediation is inessential to real activity. To ensure an active role for financial intermediaries, technological frictions such as asset indivisibility and imperfect risk diversification are usually considered. Of course, financial intermediaries can arise to overcome incentive frictions due to asymmetric information with respect to borrowers and incompleteness of financial contracts (Townsend, 1983; Bernanke and Gertler, 1989). See Pagano (1993), Galetovic (1994) and Becsi and Wang (1997) for critical literature surveys.

<sup>4</sup>The funds pooling idea is, also, explored by Besley, Coate and Lourt (1993) in their study of the workings of the ROSCA and by Cooley and Smith (1996) in their analysis of indivisible assets.

have too little wealth to finance projects by themselves or diversify away firm-specific risks.<sup>5</sup>

However, as Stiglitz (1993) and others have remarked, the literature has overlooked that markets with economies of scale can be imperfectly competitive.<sup>6</sup> This neglect may be innocuous when thinking about countries where there are many small banks, but it is less so for many countries where there exist few large banks. In contrast, our paper considers the endogenous determination of market structure for both the real and the financial sectors. Thus, we depart from the previous literature by allowing both real and financial sectors to be monopolistically competitive in the sense of Chamberlin. Intermediate goods-producing start-ups have fixed setup costs, which imply increasing returns and justify the construction of a monopolistically competitive intermediate goods sector. Similarly, financial intermediaries pay fixed setup costs and act monopolistically competitive in the loan market; their number, too, is determined endogenously. Thus, market structures and competitiveness in both sectors are endogenous, determined by exogenous intermediation and production costs as well as other preference and technology parameters.

Greater competitiveness in product and financial markets is equivalent to a greater variety or sophistication of products and services. Variety can be thought of as one form of profit-driven innovation, an idea familiar from the endogenous growth literature. As in neo-Schumpeterian endogenous growth models, greater variety or competition in the product market directly increases aggregate production. As Romer (1986) notes the effect is formally indistinguishable from an externality. While not critical for our main results, we also allow financial market competition to increase production possibilities. However, we

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<sup>5</sup> Also, fixed bank setup cost exceed average wealth. Thus, individuals must pool their funds in order to pay the fixed cost and be able to gain access to banking services. We do not consider the possibility that fixed costs of forming coalitions may exceed potential profits.

<sup>6</sup> An exception is Williamson (1986b) who analyzes how the monopoly power of a fixed number of banks affects real activity and how the number of households may have external effects on the operation of the financial sector. Also, Allen and Gale (1993) analyze the effects of imperfect competition on financial markets. However, their emphasis is on risk-sharing and financial instruments while banks are not explicitly analyzed.

posit that this occurs indirectly by lowering producers' fixed costs.<sup>7</sup> This externality can be thought of in many ways. For instance, much financial innovation shows up as new services or instruments that transform firms' cost structure from sunk costs to variable costs, leasing being a notable example. Alternatively, with greater competition comes improved access to loan services, more public information and reduced search costs all of which lower the up-front costs to producers. Finally, more financial intermediaries can be thought of as reducing the aggregate probability of being denied a loan thus lowering the cost of obtaining funds.

A central concern of the present paper is how the "industrial organization" of the banking and production sectors influences real and financial development. We show that the competitiveness of intermediate goods producers has two opposing effects on intermediate goods production. On the one hand, more goods market competition produces a "market-induced demand" effect that increases the size of investment loans; on the other, more competition creates an "intermediate-goods mark-up" effect that reduces loan sizes. The two opposing effects are a primary reason for the existence of multiple steady-state equilibria in our model. The competitiveness of financial intermediaries affects the competitiveness of intermediate goods producers mainly through production costs, which works in two conflicting ways. Market structures in both sectors are linked, because, for one, financial intermediaries exercise market power as a lender to start-ups in the intermediate goods sector. Thus, more financial market competition has a positive "financial mark-up" effect on variable costs by narrowing the spread between lending and borrowing rates. Alternatively, more competition has a negative external effect on fixed costs by reducing the setup costs of intermediate goods firms, which can be referred to as the "thick-market externality" effect.<sup>8</sup> Thus, the industrial organization of banking and production sectors becomes an integral part of the

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<sup>7</sup> Similarly, Aghion and Howitt (1992) assume externalities from innovations affect production costs. However, in their model innovations are variable cost-reducing.

<sup>8</sup> The thick-market externality is different than Diamond's (1982) trade or search externalities. We show later that the multiplicity originates from monopolistic competition, *not* from the externality.

dynamic interactions between financial and real activities through these four channels.

The main focus of our paper is the characterization of steady-state equilibria with a financially intermediated production. In particular, we examine how preference, technology and cost parameters affect the degree of financial deepening and production specialization, the loan-deposit interest spread, and the saving rate, as well as the entry of intermediate good and banking firms. We show the properties of the multiple equilibria vary with the degree of sophistication in the intermediate goods production process. More specifically, for a more developed economy, technological advances result in production specialization and financial deepening and discourage banking competition, whereas banking development that reduces the costs of financial intermediation narrows the interest rate spread, leading to production specialization and financial deepening, encouraging banking competition and reducing the size of loans. For a less developed economy, some of these findings may change, thus explaining the “stage-dependent financial development” observation. Moreover, our results suggest that the degree of competitiveness of the product market compared to that of the financial market depends on the stage of development with a negative correlation found in developed economies and a positive correlation in less developed economies. This provides a theoretical explanation for the “heterogenous market structures” observation. Finally, we find that the relationships between financial deepening, the saving ratio, and real output may also vary, depending on the competitiveness of the intermediate goods sector.

## II. THE MODEL

There are three sectors. The final goods sector produces a single final good from two sources. The first source is output from a “traditional” technology that is a linear function of productive capital. The second source of output is a “modern” technology employing reproducible intermediate goods as specified in Romer (1986) in which the breadth of intermediate products enhances output. The first source

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However, financial market thickness does increase the likelihood of indeterminacy.

of output acts as an outlet for savings and a source of consumption when the modern technology is not feasible. The modern technology can be an engine of economic development through increases in the number of intermediate goods that can be regarded as enabling a sophisticated production process with increased specialization. It is feasible to produce with the modern technology once a fixed setup cost is paid. While the composition of savings matters for development, we focus on equilibria where individuals have moved from direct capital accumulation via the traditional sector to financially intermediated accumulation via the modern sector. Thus, we introduce the non-intermediated “traditional” sector simply to establish conditions under which financial intermediation emerges.

An intermediate goods firm can produce only after it pays a fixed start-up cost. Intermediate goods are produced using bank-financed capital according to a decreasing-returns technology that permits a positive markup to cover the start-up cost.<sup>9</sup> While individual firms are monopolistically competitive in the output market, they are perfectly competitive in the input market. The output of each intermediate goods firm is subject to an idiosyncratic random shock. The firms producing intermediate goods arrange financing with the banking sector before the realization of this shock. Start-up costs and idiosyncratic risks require pooling of funds and risks and give rise to the banking sector.

Banks pool risks by offering households a safe rate of return on the interest-bearing portion of their deposit. They also pool household funds to finance the fixed start-up costs of the intermediate goods firms. The financial intermediary sector is also monopolistically competitive. There is a fixed cost for setting up a bank. Individual banks can affect their lending rates to the intermediate goods producers, but competition

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<sup>9</sup> Without loss of generality, this paper focuses primarily on the behavior of banks, because banks are typically the sole financial agents in LDCs and are also very important even in advanced economies. Mayer (1990) shows, among eight industrialized countries during 1970-85, intermediated loans were the dominant source of external funds, generally contributing a greater share of external financing than short-term securities, bonds and shares combined. Thus, throughout the paper, we will use the terms “bank” and “financial intermediary” interchangeably.



forces them to break even.<sup>10</sup> By allowing monopolistic competition in both the intermediate goods and banking sectors, we can relate financial deepening to production specialization.

Households choose a path of consumption of a single good, shares of productive capital in the traditional sector, and the amount of funds to be deposited with the banking sector. During any particular period, banks determine the total amount of funds lent to the intermediate goods sector at the same time they set the interest rate on deposits but prior to realization of the random output shocks in the intermediate goods sector. This is possible because banks are assumed to know the distribution of shocks and returns. After the uncertainty in the intermediate goods sector is resolved, the amount of intermediate goods production is determined, after which final goods are produced.

At this point we want to emphasize that the traditional sector exists simply to establish a rate-of-returns-dominancy condition under which the financial sector emerges. It is not the purpose of this paper to study the development process from traditional to modern production technology. Rather, the focus of the paper is to understand the steady-state properties of the financially intermediated equilibrium. Second, idiosyncratic risks in the intermediate goods sector help justify the active role of banks in addition to banks' funds-pooling function. Our handling of the uncertainty aspect is in a barebone fashion to focus on the characterization of a symmetric, certainty-equivalent equilibrium. The main emphasis of the paper is to highlight the role of endogenous market structures of the intermediate goods and the financial sectors.

We characterize the optimizing behavior of households, banks, intermediate goods producers, and final good producers, respectively, in the following subsections. A brief summary of the structure of the model is provided in Figure 1 (with notation to be defined later).

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<sup>10</sup> We do not consider market power of the intermediary vis-à-vis households for analytical tractability. Williamson (1986b) imposes a similar assumption based on the observation that there are few substitutes for intermediary loans but many for intermediary deposits (such as government securities). That is, individual banks have monopoly power only over the market for loans and act as price-takers in the market for deposits.

## IIA. Households

The economy is populated by a continuum of households of mass 1. Household preferences are given by the standard time separable utility function  $\sum_{t=0}^{\infty} \beta^t \ln(c_t)$  where  $c_t$  denotes consumption at date  $t$  and the discount factor  $\beta$  satisfies  $0 < \beta < 1$ . The representative household enters period  $t$  holding bank deposits,  $b_t$ , and a stock of physical capital, all of which is employed in the final goods sector,  $k_t^y$ . During the period, these assets generate (gross) rates of return of  $(1 + r_t^b)$  and  $(1 + r_t^y)$  respectively.<sup>11</sup> The representative household faces the budget constraint

$$c_t + b_{t+1} + k_{t+1}^y = (1 + r_t^b)(b_t - e_t^b) + (1 + r_t^y)k_t^y \quad (1)$$

with  $b_0$  and  $k_0^y$  given. Here  $b_{t+1} - b_t$  is the total amount of funds supplied to the banking sector during period  $t$ , which consist of interest-bearing deposits,  $b_t$ , and a banking fee,  $e_t^b$ . For analytic convenience, we assume that this fee is levied proportional to household funds, i.e.,  $e_t^b = e_0 b_t$ , where  $e_0 > 0$ .

## IIB. Production

Production of the final (consumption) good is carried out by means of the composite technology

$$y_t = \max \{ A_t^y k_t^y + F(\{x_t(i)\}_{i=0}^{N_t}, N_t) - \Omega^y, 0 \} \quad (2)$$

The composite technology consists of a linear “traditional” technology  $A_t^y k_t^y$  and a “modern” technology  $(F(\{x_t(i)\}_{i=0}^{N_t}, N_t))$ . The constant-returns traditional technology is introduced for convenience and plays little role in driving any of the results except to produce a simple condition to ensure the emergence of financial intermediation. The modern technology is assumed to take the Romer (1986) form:

$$F(\{x_t(i)\}_{i=0}^{N_t}, N_t) \equiv \int_0^{N_t} x_t(i)^\rho di \text{ with } 0 < \rho \leq 1 \text{ which is a strictly concave production function that is}$$

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<sup>11</sup>That is, interest rates subscripted period  $t$  denote returns from holding instruments between periods  $t-1$  and  $t$ .

homogeneous of degree  $\rho$ . Thus output of the final good depends on capital allocated to final goods production  $k_t^y$  and a variety of intermediate inputs  $x_t(i)$ , where the number (or, more precisely, mass) of intermediate goods is measured by  $N_t$ . Neither input is essential to production since final good output can be produced using either intermediate goods, direct capital or both. The adoption of the Romer technology in the modern sector gives rise to a simple analysis of a non-trivial mark-up.<sup>12</sup> We also assume that there is a fixed cost associated with production of the final good,  $\Omega^y$ , which exceeds the wealth of any single individual. The existence of this cost prevents any one individual from owning a final-goods producing firm.<sup>13</sup>

The optimization problem faced by the final goods producer is as follows:

$$\max_{k_t^y, x_t(i)} \pi_t^y = y_t - \int_0^{N_t} q_t(i) x_t(i) di - r_t^y k_t^y \quad (3)$$

where  $y_t$  is given by (2),  $q_t(i)$  denotes the price of the  $i$ 'th intermediate good and we assume that the final good is the numeraire.

The technology for producing the intermediate goods is given by the following:

$$x_t(i) = \max \{A_t^x(i) G(k_t^x(i)) - \Omega^x(M_t; i), 0\} \quad (4)$$

where  $k_t^x(i)$  denotes capital allocated to production of the  $i$ 'th intermediate good, and the production technology is specified as:  $G(k^x(i)) \equiv k^x(i)^\alpha$ ,  $0 < \alpha < 1$ . We also assume that there is a fixed cost associated with the production of the intermediate goods,  $\Omega^x$ . One can think of this fixed cost as primarily

<sup>12</sup> The Dixit-Stiglitz type constant-returns-to-scale form will always produce a constant mark-up, independent of economic activity.

<sup>13</sup> A similar assumption below will ensure that no individual can internally finance the production of intermediate goods. These assumptions highlight the funds pooling role of financial intermediaries, which has been supported historically by the emergence of the informal "rotating savings and credit association" (ROSCA). See Besley, Coate, and Louny (1993).

the establishment cost incurred in starting up a project,  $x(i)$ , that requires external finance. In other words, it is the cost of putting together the financing needed to operate the  $i$ 'th intermediate goods investment project for one period. Furthermore, this cost is assumed to depend on the number of monopolistic banks. Specifically, an increase in the number of banks ( $M_t$ ) will intensify financial market thickness and financial innovation that reduce the resources needed to put together the financing for intermediate goods production.<sup>14</sup> Accordingly, we hypothesize that the fixed cost has the form  $\Omega^x(M_t; i) \equiv \Omega_0^x M_t^{-\gamma}$ ,  $\gamma > 0$ .<sup>15</sup> In short, this consideration captures the Diamond-like thick-market externality in a different context.

The profit maximization problem faced by the typical intermediate goods producer is as follows:

$$\max_{k_t^x(i)} \pi_t^x(i) = q_t(i) x_t(i) - (1 + r_t^k(i)) k_t^x(i) \quad (5)$$

where the technology for producing  $x_t(i)$  is specified as in (4) and  $1 + r_t^k(i)$  is the gross unit cost of capital (i.e., the cost from the principle and the interest of the bank loan).

For simplicity, we assume that  $A_t^x(i)$  has a stationary distribution with two possible realizations  $\{(1+\delta)A, (1-\delta)A\}$  with  $Pr(A^x(i) = (1+\delta)A) = \theta(i)$  and  $Pr(A^x(i) = (1-\delta)A) = 1 - \theta(i)$  where  $A > 0$  and  $0 < \delta < 1$ . Denote the certainty equivalent value of  $A^x$  as  $\bar{A}^x$ . In the steady-state analysis below, we will consider only the symmetric, certainty-equivalent equilibrium allocation, which enables us to focus on the relationships between financial deepening and production specialization. Throughout the paper, we will refer to an increase in  $A$  as a positive technological shock and will assume that the bank knows the distribution  $\Theta$  that generates the outcomes of this process but not the individual realizations of  $\theta(i)$  across firms. This *ex-ante* uncertainty about the outcomes of investment projects is used only to

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<sup>14</sup> We can use  $N$  and  $M$  to indicate the degree of competitiveness in the corresponding market. Note that since both are measures (rather than cardinalities), pure monopoly requires these values approaching zero (rather than unity).

<sup>15</sup> If we reinterpret our start-up cost as the information acquisition cost considered in Williamson (1986b), then his setup regarding the production fixed cost can be encompassed by our form with  $\gamma = 0$ .

motivate the existence of financial intermediation and is inessential to our main points.

## II.C. The banking sector

Households make deposits with banks that are then lent to firms in the intermediate goods sector.

The bank's profit maximization problem is as follows:

$$\max_{D_{t+1}, L_{t+1}} \pi_t^b = E_t \int_0^{N_{t+1}} (1 + r_{t+1}^k(i)) L_{t+1}(i) di - (1 + r_{t+1}^b) D_{t+1} - \Omega^b - \int_0^{N_{t+1}} \mu(i) L_{t+1}(i) di \quad (6)$$

subject to the balance sheet constraint

$$\frac{e_{t+1}^b}{M_{t+1}} + D_{t+1} = \int_0^{N_{t+1}} L_{t+1}(i) di \quad (7)$$

Here  $\mu(i)$  denotes the unit cost of processing a loan to the  $i$ 'th intermediate goods industry, while  $\Omega^b$  is the fixed cost incurred to set up and run a bank.<sup>16</sup> Note that with the balance sheet identity (7), it is a matter of indifference whether we specify the bank's profit function using gross or net rates of interest. Also, risk-neutral banks pool loans with firm-specific risks to achieve risk diversification.<sup>17</sup> For simplicity, the funds obtained from households,  $b_{t+1}$ , and the loans made to intermediate goods producers,  $k_{t+1}^x(i)$ , are assumed to be distributed equally over all  $M_{t+1}$  banks.<sup>18</sup> The household funds are divided into net deposits,  $D_{t+1}$ ,

<sup>16</sup> The existence of such a fixed cost is consistent with empirical evidence of financial economies to scale for small banks (Berger et al., 1993 and Clark, 1988) and a negative correlation of unit bank costs and financial development (Sussman and Zeira, 1995).

<sup>17</sup> Each bank holds a market portfolio of loans that is not accessible to households unless they can afford to pay the fixed costs. Thus, banks act like a mutual fund. While a stock market could perform the same function, one does not observe widespread direct (and diversified) holding of equities or loans.

<sup>18</sup> As Allen (1991) points out, firms tend to have relationships with many financial intermediaries simultaneously. Households also have simultaneous relationships although maybe to a lesser extent.

and banking fees,  $e_{t+1}^b$ , that are earmarked as bank capital.<sup>19</sup> Thus, equating funds inflows and outflows gives:

$$D_{t+1} = \frac{b_{t+1} - e_{t+1}^b}{M_{t+1}} \quad (8a)$$

$$L_{t+1}(i) = \frac{k_{t+1}^x(i)}{M_{t+1}} \quad (8b)$$

### III. OPTIMIZATION

We characterize the equilibrium using the first-order conditions for each sector's optimization problem. First, from the **Final Goods Sector** we obtain the following first-order conditions for an interior equilibrium:

$$A_t^y = r_t^y \quad (9)$$

$$q_t(i) = \frac{\partial F(\{x_t(i)\}_{i=0}^{N_t}, N_t)}{\partial x_t(i)} = \rho \int_0^{N_t} x(i)^{\rho-1} di = q_t \quad (10)$$

These conditions plus the assumptions of free entry and symmetry (such that  $x(i) = \bar{x}$  for all  $i$  and thus  $\int_0^N x(i) di = \bar{x}N$ ) allow us to write

$$N\bar{x}^\rho = \frac{\Omega^y}{1 - \rho N} \quad (11)$$

where for convenience we have dropped all time subscripts. To ensure that intermediate goods production

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<sup>19</sup>Banking fees are a real resource cost for households. There will be a cost to society if some percentage of these fees “evaporates” as banks transform deposits to loans.

is positive, we assume  $N < 1/\rho$ . Substituting (11) into (10) yields

$$q(N, \bar{x}) = \rho N \bar{x}^{\rho-1} = \rho \frac{\Omega^y}{(1 - \rho N) \bar{x}} \quad (12)$$

Thus, intermediate input prices increase with the elasticity parameter  $\rho$ .<sup>20</sup>

In the **Intermediate goods Sector** we also focus on an interior solution and the first-order condition (conditional on realizations of  $A^x(i)$ ),<sup>21</sup>

$$\rho q_t(i) \frac{dx_t(i)}{dk_t^x(i)} = \rho q_t(i) \alpha A_t^x(i) (k_t^x(i))^{\alpha-1} = (1 + r_t^k) \quad (13)$$

In obtaining the first equality, we have imposed *ex post* symmetry for the intermediate goods firms. Under symmetry, the free entry condition for the intermediate goods sector is simply  $q_t \bar{x}_t = (1 + r_t^k) k_t^x$ .

Combining equation (13) with the free entry condition and the technology (4) gives us the following expressions for the supply of intermediate goods ( $x_t^s$ ), the capital stock allocated to intermediate goods production and the gross loan rate:

$$x_t^s = \frac{\rho \alpha}{1 - \rho \alpha} \frac{\Omega_0^x}{M_t^y} \quad (14)$$

$$1 + r_t^k = \rho q(N, \bar{x}) \alpha A_t^x (k_t^x)^{\alpha-1} \quad (15)$$

$$k_t^x = \left[ \frac{\Omega_0^x}{A_t^x (1 - \rho \alpha) M_t^y} \right]^{\frac{1}{\alpha}} \quad (16)$$

<sup>20</sup> Notice that under the Romer-type technology (which differs from the Dixit-Stiglitz form), the elasticity is no longer fixed.

<sup>21</sup> Optimization with monopoly power implies:  $q_t(i) \frac{dx_t(i)}{dk_t^x(i)} + x \frac{dq_t(i)}{dx_t(i)} \frac{dx_t(i)}{dk_t^x(i)} = 1 + r_t^k(i)$ .

As monopoly power of the individual firms increases or as the elasticity of demand falls (lower  $\alpha$  or  $\rho$ ), the mark-up of each intermediate goods producer increases, thus allowing for a higher loan rate while maintaining zero profit.

Equating demand for intermediate goods from (11) and supply from (14) yields an expression for the equilibrium number of intermediate goods firms

$$N(1 - \rho N) = \Omega^y \left( \frac{1 - \rho\alpha}{\Omega_0^x \rho \alpha} \right)^\rho M^{\rho\gamma} \quad (17)$$

The (*ex-ante*) first-order conditions of the **Banking Sector** are

$$r_{t+1}^k(i) \{1 - E_{r^k L}^i\} - \mu(i) = r_{t+1}^b \quad (18)$$

where  $E_{r^k L}^i \equiv -[L(i)/r^k(i)][dr^k(i)/dL(i)]$  is the inverse of the interest rate elasticity of the demand for bank loans. It can be shown that the financial mark-up (of the loan rate over the deposit rate) is  $r^k(i) E_{r^k L}^i = (1 - \alpha)(1 + r^k)$ .<sup>22</sup> The mark-up term is inversely related to the bank's degree of market power, since as  $M$  goes to infinity,  $r^k E_{r^k L}$  goes to zero. Using this to replace the mark-up term in (18) yields  $r_{t+1}^k = (r_{t+1}^b + \mu + (1 - \alpha))/\alpha$  where we have invoked symmetry and dropped the index for individual intermediate goods producers. The loan-deposit interest rate differential is thus

$$r_{t+1}^k - r_{t+1}^b = \frac{1}{\alpha} \{ (1 - \alpha)(1 + r_{t+1}^b) + \mu \} = (1 - \alpha)(1 + r_{t+1}^k) + \mu \quad (19)$$

so that  $(r^k - \mu) - r^b = (1 - \alpha)(1 + r^k)$ . In a perfectly competitive framework  $\alpha = 1$ , the mark-ups of the firms are driven to zero and the loan-deposit interest rate differential is nothing but the unit loan

<sup>22</sup> Inserting (8) into (16) yields:  $1 + r^k(i) = \rho q \alpha A^x (ML(i))^{\alpha-1}$ . Thus, we have  $(r^k/(1 + r^k))(dr^k/r^k) = (\alpha - 1)dL/L$ , which proves the claim.



processing cost,  $\mu$ .

Equations (6), (7), (8) and (19) can be combined to yield:

$$[(1 - \alpha(1 - e_0))(1 + r_{t+1}^k) - e_0\mu] N_{t+1} k_{t+1}^x = \Omega^b M_{t+1} \quad (20)$$

$$b_{t+1} = N_{t+1} k_{t+1}^x \quad (21)$$

Before proceeding we might note that we can get a preview of some of our main results from an examination of equations (17) and (20). Recall that equation (17) is the expression for the equilibrium number of intermediate goods firms. This equation defines the locus GG in Figure 2. The GG locus has a unique peak at  $N = 1/(2\rho)$ . Equation (20) also gives us a relationship between the size of the banking sector and the size of the intermediate goods sector. This relationship is linear with a slope determined by (among other things) the fixed cost associated with the operation of a bank, bank capital requirements, and the cost of processing loans. This locus is plotted as BB and BB' in Figure 2, illustrating two possible equilibria at  $E_0$  and  $E_1$ .

Throughout the analysis we have assumed a thick market externality that arises from the existence and development of the banking sector. This externality is captured by allowing the fixed cost of putting together the financing for an intermediate goods project to decline with the size of the banking sector, i.e. by allowing  $\gamma > 0$ . To see what a difference the existence of this externality makes to our analysis, Figure 3 shows the equilibrium values for N when we assume that  $\gamma = 0$ . In the absence of the externality, the equilibrium size of the intermediate goods sector is determined by equation (17) alone. Figure 3 shows two possible solutions,  $E_0$  and  $E_1$ . Thus, the thick market externality *per se* plays no role in generating the possibility of multiple equilibria.

To close the system we assume that the returns from the intermediate goods (or “high tech”) sector

dominate those of the final goods (or “traditional”) sector, so that  $E_t r_{t+1}^b > E_t r_{t+1}^y$  which ensures the existence of the banking sector.<sup>23</sup> Then the **Household Sector's** first-order conditions are

$$c_t = (1 + r_t^b(1 - e_0))b_t - b_{t+1} \quad (22)$$

$$1 = E_t \left[ \beta (1 + (1 - e_0)r_{t+1}^b) \frac{c_t}{c_{t+1}} \right] \quad (23)$$

which can be combined to yield

$$1 = E_t \left[ \beta (1 + (1 - e_0)r_{t+1}^b) \frac{b_t}{b_{t+1}} \frac{(1 + (1 - e_0)r_t^b) - \frac{b_{t+1}}{b_t}}{(1 + (1 - e_0)r_{t+1}^b) - \frac{b_{t+2}}{b_{t+1}}} \right] \quad (24)$$

We can now summarize all optimization, feasibility, technology and free entry conditions to define an interior, financially intermediated equilibrium,

- Definition 1.** *An equilibrium with financial intermediation (EFI) is a tuple of positive quantities and prices  $\{c_t, b_t, x_t, k_t^x, y_t, D_t, L_t, N_t, M_t, r_t^b, r_t^k, q_t\}_{t \geq 0}$  satisfying:*
- (i) *(consumer optimization and budget constraints) equations (22) and (23);*
  - (ii) *(final-good producer optimization and technology) equations (2) and (10);*
  - (iii) *(intermediate-goods producer optimization, technology and free entry) equations (14)-(16);*
  - (iv) *(bank optimization, free entry and balance sheet conditions) equations (8a), (8b), (18), (20) and (21);*
  - (v) *(active financial intermediation)  $E_t r_{t+1}^b > E_t r_{t+1}^y$ .*

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<sup>23</sup> This assumption also implies that in the steady-state equilibrium there will be no output produced by means of the “traditional” technology and all output will be intermediated.

#### IV. STEADY-STATE EQUILIBRIUM

Throughout the rest of the paper, we will focus only on characterizing the properties of steady-state equilibrium with financial intermediation. Consider,

**Definition 2.** *A steady-state equilibrium with financial intermediation (SSEFI) is an EFI with all quantities and prices converging to some positive constant values.*

Thus, from (24) we obtain the steady-state deposit rate:

$$r^b = \frac{\beta^{-1} - 1}{1 - e_0} \equiv r^b(\beta, e_0) \quad (25)$$

where  $\partial r^b / \partial \beta < 0$ ,  $\partial r^b / \partial e_0 > 0$ . In the absence of the banking fee,  $e_0 = 0$  and the steady-state deposit rate is simply the pure rate of time preference. The steady-state loan rate is then obtained using equations (19) and (25):

$$r^k = \frac{1}{\alpha} \left( \frac{\beta^{-1} - 1}{1 - e_0} + \mu + (1 - \alpha) \right) \equiv r^k(\beta, e_0, \mu, \alpha) \quad (26)$$

where  $\partial r^k / \partial \beta < 0$ ,  $\partial r^k / \partial e_0 > 0$ ,  $\partial r^k / \partial \mu > 0$ , and  $\partial r^k / \partial \alpha < 0$ . Thus, an increase in the consumer banking fee or the loan processing cost or the mark-up of the intermediate good producers will lead to a higher steady-state loan rate.

Equation (11) allows us to write

$$x = \left( \frac{\Omega^y}{N(1 - \rho N)} \right)^{\frac{1}{\rho}} \equiv x(N; \Omega^y, \rho) \quad (27)$$

where  $\partial x / \partial N > (<) 0$  iff  $N > (<) 1/(2\rho)$ ,  $\partial x / \partial \Omega^y > 0$  and the effect of  $\rho$  on  $x$  is ambiguous. Thus, when  $N$  is sufficiently small, an increase in the number of intermediate goods firms lowers the scale of

production for each individual firm.

Utilizing equations (11) and (12), we have the following expression for  $q$ :

$$q = \rho \left( \frac{(1-\rho N)}{\Omega^y} \right)^{\frac{1}{\rho}-1} N^{\frac{1}{\rho}} \equiv q(N; \Omega^y, \rho) \quad (28)$$

where  $\partial q / \partial N > (<) 0$  iff  $N < (>) 1/[\rho(2-\rho)]$ , and  $\partial q / \partial \Omega^y < 0$ ; again, the sign of  $\partial q / \partial \rho$  is ambiguous.

When  $N$  is sufficiently small, an increase in  $N$  raises the marginal product of  $x$  (and thus  $q$ ) due to a lower  $x$  and a wider range of intermediate products. In this case, the aggregate induced demand effect on  $x$  dominates the intermediate-good mark-up effect. In order for the negative markup effect to dominate, a larger critical value of  $N$  is required, specifically  $1/[\rho(2-\rho)]$  which is greater than  $1/(2\rho)$ .

To characterize the steady-state value of  $M$ , we manipulate (17) to obtain

$$M = \left( \frac{\rho \alpha \Omega_0^x}{1-\rho \alpha} \right)^{\frac{1}{\gamma}} \left( \frac{N(1-\rho N)}{\Omega^y} \right)^{\frac{1}{\rho \gamma}} \equiv M(N; \Omega_0^x, \Omega^y, \alpha, \gamma, \rho) \quad (29)$$

where  $\partial M / \partial N > (<) 0$  iff  $N < (>) 1/(2\rho)$ ,  $\partial M / \partial \Omega^y < 0$ ,  $\partial M / \partial \Omega_0^x > 0$ , and  $\partial M / \partial \alpha > 0$ , while the effect of  $\rho$  is ambiguous. From equation (14), since  $\Omega^x$  depends negatively on  $M$ , the number of banks and the scale of production for each intermediate goods firm must be inversely related. Consequently, when  $N$  is sufficiently small (large), an increase in  $N$  will be associated with a larger (smaller)  $M$ . How  $M$  and  $N$  are related depends crucially on how the competitiveness of banks affects the costs of intermediate goods production. The negative correlation between  $M$  and  $N$  arises because as  $M$  increases banks increase the interest rate spread (or the financial mark-up) to offset falling profit margins in the banking sector. The increase the interest rate spread lowers profit margins for intermediate goods producers causing  $N$  to fall. By contrast, the thick financial markets externality through the setup costs of intermediate goods producers causes  $M$  and  $N$  to be positively correlated. This effect is dominant when  $N$  is small (and only arises

when  $\gamma$  is not zero). Thus, in general, the market structures of the intermediate goods sector and of the banking sector may not be parallel: it is possible to have a highly concentrated banking sector with very competitive intermediate goods production, or *vice versa*.

Next, substituting (29) into (15) we can derive a relationship between  $k^x$  and  $N$  that consolidates the implications of the free entry assumption:<sup>24</sup>

$$k^x = \left( \frac{1}{\rho \alpha \bar{A}^x} \right)^{\frac{1}{\alpha}} \left( \frac{\Omega^y}{N(1-\rho N)} \right)^{\frac{1}{\alpha \rho}} \quad (30)$$

We can also use equations (16) and (26) to obtain another relationship between  $k^x$  and  $N$  that summarizes the implication of the assumption that production is carried out efficiently:

$$1 + \frac{1}{\alpha} \left( \frac{\beta^{-1}-1}{1-e_0} + \mu + (1-\alpha) \right) = \alpha \bar{A}^x \rho^2 \left( \frac{1-\rho N}{\Omega^y} \right)^{\frac{1}{\rho}-1} N^{\frac{1}{\rho}} (k^x)^{\alpha-1} \quad (31)$$

Finally, it remains to derive the steady-state levels of  $b$ ,  $c$ ,  $D$  and  $L$ . From equation (21) we find that  $b = N k^x$ , while from (22) steady-state consumption can be expressed as  $c = r^b b(1-e_0) = r^b N k^x(1-e_0)$ . The steady-state values of  $D$  and  $L$  are obtained from equations (8a) and (8b). Of course, by Walras's law, one of the constraints and equilibrium conditions is redundant and thus need not be used in solving the steady state.

The results of this section can be summarized with the following proposition:

**Proposition 1.** (Existence) *Under proper conditions, there exists steady-state equilibrium with financial intermediation which has a block-recursive structure,*

- (i) *steady-state equilibrium  $(r^b, r^k)$  are determined by (25) and (26);*

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<sup>24</sup> Recall that the following relationship is derived from equation (19) which is obtained based on the manipulated form of the free-entry condition, (17).

- (ii) *steady-state equilibrium  $(k^x, N)$  are determined by (30) and (31);*
- (iii) *steady-state equilibrium  $(x, q, M)$  are determined by (27)-(29);*
- (iv) *steady-state equilibrium  $(c, b, D, L)$  are determined subsequently by the steady-state version of equations (8a), (8b), (21) and (22).*

The key task for characterizing the steady-state equilibria is to examine  $(k^x, N)$  using (30) and (31). For illustrative purposes, we will call the “free entry” relationship, (30), the **FE locus** and the “production efficiency” relationship, (31), the **PE locus** (see Figures 4a,b). It is straightforward to show that the FE locus is U-shaped, with a trough at  $N = 1/(2\rho)$ , and two vertical asymptotes at  $N = 0$  and  $N = 1/\rho$ . Equation (15) implies that  $k^x$  and  $M$  are inversely related. The discussion of equation (29) therefore indicates that the effect of  $N$  on  $k^x$  is negative (positive) as  $N$  is sufficiently small (large). Notably, the non-monotonicity of the FE locus is mainly due to the thick-market externality in that a thicker financial market associated with greater entry of banks leads to a lower real cost for intermediate goods producers to start up an investment project.<sup>25</sup>

On the other hand, the PE locus is bell-shaped with a peak at  $N = 1/(2\rho - \rho^2) > 1/(2\rho)$ . The shape of the PE locus is determined primarily by the effect of the competitiveness of intermediate goods firms,  $N$ , on the price of intermediate goods,  $q$ . Along the PE locus, the value of the marginal product of capital  $k^x$  is equal to the rental price  $1 + r^k$ . From equation (16), the value of the marginal product of capital depends positively on the marginal product for any given  $k^x$  and on  $q$  which equals the marginal product of  $x$ . The discussion of equation (28) thus implies that when  $N$  is sufficiently small, an increase in  $N$  will, by enlarging the market (induced) demand, raise the value of the marginal product of capital for fixed  $k^x$ . In order to maintain the value of the marginal product of capital at a constant rental price,  $k^x$

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<sup>25</sup> As the reader can easily check, the FE locus is horizontal when there is no thick-market externality; ie. when  $\gamma = 0$ , equation (15) is independent of  $M$  (and hence  $N$ ).

must increase given diminishing returns. Alternatively, when  $N$  is large the intermediate-good mark-up effect dominates the induced demand effect so that an increase in  $N$  lowers  $q$  and the value of the marginal product of capital and causes  $k^x$  to fall. Thus, it is the opposing effects of market demand and intermediate-good mark-up that give the non-monotonic shape to the PE locus. Importantly, the non-linear behavior underlying the product efficiency condition for the intermediate goods market is the key driving force to the multiplicity result to be derived below.

The position of the FE locus is determined by the values of  $\Omega^y$ ,  $A^x$ ,  $\alpha$ , and  $\rho$ , while the position of the PE locus will be determined by  $\Omega^y$ ,  $A^x$ ,  $\beta$ ,  $e_0$ , and  $\mu$ . More specifically, for fixed  $N$ , an increase in  $\Omega^y$  or a decrease in  $A^x$  discourages the entry of intermediate goods firms, thus requiring  $k^x$  to increase to maintain zero profit. This is reflected by an upward shift of the FE-locus. For fixed  $N$ , an increase in  $\Omega^y$  or a decrease in  $A^x$  reduces the value of the marginal product of capital. Given the same rental price,  $k^x$  must decrease to raise the value of the marginal product of capital to the original level and the PE-locus shifts down. On the other hand, a decrease in  $\beta$  or an increase in  $e_0$  or  $\mu$  raises the rental price of capital. For fixed  $N$ ,  $k^x$  must fall so that the value of the marginal product of capital will increase to maintain equality with the higher rental price. Thus, the PE-locus shifts down and the FE-locus is unaffected.

For sufficiently high  $A^x$ ,  $e_0$ , and  $\mu$ , or for sufficiently low  $\Omega^y$  and  $\beta$ , the two curves will intersect each other twice to produce a high- $N$  equilibrium and a low- $N$  equilibrium.<sup>26</sup> Since  $1/[\rho(2-\rho)] > 1/(2\rho)$ , around the high- $N$  equilibrium the FE locus must be upward-sloping and the PE locus must be downward-sloping. However, around the low- $N$  equilibrium, while the PE locus must be upward sloping, the slope of the FE locus could be negative (as in Figure 4a) or positive (as in Figure 4b). We will refer to the high- $N$  equilibrium (H) as the benchmark case I and the other two types of equilibria, low- $N$  (L in Figure 4a) and intermediate- $N$  (I in Figure 4b) as the alternative cases II and III, respectively. Note that even when

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<sup>26</sup> This can be easily shown by establishing the condition under which the minimum value of  $k^x$  of the FE locus is strictly less than the maximum value of  $k^x$  of the PE locus.

$\gamma = 0$  and the FE locus is horizontal, cases I and II still arise. Therefore, the thick-market externality only increases the types of equilibria from two to three by allowing for the intermediate- $N$  equilibrium but is not essential in obtaining multiplicity in the first place. This differs from the financial fragility model of Cooper and Ejarque (1994) in which multiple equilibria occur as a result of the participation externality (in that a larger mass of agents joining the intermediary can lower the fixed setup costs). These results can be summarized by,

**Proposition 2.** (Multiplicity) *In general, there are multiple steady-state equilibria with financial intermediation, depending on the degree of competitiveness of the financial and intermediate goods markets.*

## V. COMPARATIVE-STATIC ANALYSIS

We will begin by focusing our attention on the comparative-static results of the benchmark case (see Table 1) and relegate our discussion of the alternative cases to the end of this section to contrast with the benchmark case. An autonomous increase in the fixed cost of intermediate goods production,  $\Omega_0^x$ , requires a more competitive banking sector to offset its negative effect. Such a change, however, will not affect any other endogenous variables. On the other hand, an increase in the fixed cost of setting up and running a banking firm,  $\Omega^b$ , reduces the profit margin and thus discourages bank entry. Again, it has no effect on any other endogenous variables, in contrast with the Cournot solution in the oligopolistic competition model of Williamson (1986b) where a higher banking fixed cost only widens the loan-deposit interest rate spread to ensure profitability without changing the number of banks. Furthermore, an increase in the fixed cost of final goods production,  $\Omega^y$ , has a direct positive effect on capital and intermediate goods production as well as a direct negative effect on the price of the intermediate goods. It also reduces the degree of intermediate goods production specialization, which under the benchmark case (where



$N \in [(p(2-p))^{-1}, p^{-1}]$ ) tends to lower  $k^x$  and  $x$  and raise  $q$ . Thus, its effects on these endogenous variables are ambiguous.

A technological improvement (i.e., a higher  $A^x$ ) induces more entry into the intermediate goods sector and boosts intermediate goods production, leading to a lower price. Under the benchmark case,  $N$  and  $M$  are inversely related and a technological improvement decreases the number of banks. The financially intermediated output ( $F - \Omega^y$ ) is nonetheless unambiguously higher.

An increase in the “effective” cost of financial intermediation, due to an increase in the degree of impatience or in banking fees and loan processing costs, requires a larger loan-deposit interest rate differential to maintain profitability. A higher interest rate on loans discourages the entry of intermediate goods firms and investment in the intermediate goods sector and increases the intermediate goods price. The intermediated output falls, whereas the number of banks rises under the benchmark case.

We are now prepared to highlight the main findings for the benchmark case where the intermediate goods sector exhibits a high degree of competitiveness as measured by a high- $N$ .

**Proposition 3.** (Characterization of High- $N$  Equilibrium) *The steady-state high- $N$  equilibrium has the following features:*

- (i) *Financial deepening, production specialization and real output enhancement are positively related with respect to alternations in production technology or financial intermediation costs.*
- (ii) *The degrees of competitiveness in the banking and intermediate goods sectors are negatively related in response to production technology and financial intermediation costs variations.*
- (iii) *Reacting to shocks to financial intermediation costs or time preferences, the level of real output and the saving rate are always positively related.*

Thus, production technological advances result in a larger number of intermediate goods (product-

ion specialization), an ambiguous effect on the financial intermediation ratio (financial deepening as measured by the total intermediated loans to output ratio), but it discourages banking competition at the same time it encourages competition among intermediate goods producers. Thus, the positive correlation between production specialization and financial deepening that has been observed by Goldsmith (1969), McKinnon (1973), Shaw (1973), and King and Levine (1993) need not obtain a priori for technology shocks. However, the model does predict a positive correlation for bank cost shocks. Banking development that reduces the effective cost of financial intermediation will narrow the loan-deposit interest rate differential, discourage banking competition, and induce production specialization and financial deepening. Thus, the finding of Sussman and Zeira (1995) that the cost of financial intermediation falls as per capita output rises may be a result of bank development, and the direction of causation is theoretically indeterminate.

Moreover, banking development results in a negative correlation between the number of banks and the size of loan, consistent with the empirical findings in Petersen and Rajan (1994) using U.S. National Survey of Small Business Finances data. Furthermore, with any banking (or taste) shock, we obtain a positive correlation between financial development and the saving rate and between financial development and output.<sup>27</sup> However, for technology shocks the correlation between intermediation and development is ambiguous. The ambiguity arises because the negative direct effect is offset by the effect of increased competition among intermediate-good producers. Finally, for case I bank sector competitiveness and output are negatively correlated for most shocks. Thus, financial development and competitiveness are *not* synonymous.

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<sup>27</sup> With any shock and across all equilibria, we obtain a positive correlation between financial development and the saving rate,  $(1 - e_0)Nk^{x/y}$ . More generally, as Pagano (1993) argues, the correlation between intermediation and savings may be sensitive to how intermediation is modeled and where shocks occur. For instance, Bencivenga and Smith (1991) show that economies with intermediation need not have higher savings rates than economies without it. Such a comparison is left for future research because in our model this would involve comparing savings with a traditional sector and savings with a modern sector.

Finally, we turn to the alternative cases of low- $N$  (in that  $N < 1/(2\rho)$ ) and intermediate- $N$  (in that  $N \in [1/(2\rho), 1/(\rho(2-\rho))]$ ) equilibria (i.e., L and I in Figures 4a and 4b, respectively). It may be useful to note that all three types of equilibria may be dynamically stable and that it may be possible to have the high- $N$  equilibrium Pareto-dominate the other two in views of the consumers. Whether an economy ends up with one particular type of equilibrium will be history-dependent, relying on economic as well as institutional factors, and influenced by individual expectations, based on self-fulfilling prophecies. We will not discuss the detailed comparative statics under the two alternative cases (see Tables 2a and 2b). Instead, we will highlight a few interesting findings contrasting with the benchmark case.

On the one hand, while a positive shock to production technology increases output for all three equilibria, it results in a lower degree of production specialization for both of the alternative cases, contrary to the benchmark case. Moreover, the number of banks is lower (higher) in case II (III). Thus, one observes a parallel market structure for the real and financial sectors in the low- $N$  case but a dissimilar market structure for the two sectors in the other two cases (high- $N$  and intermediate- $N$ ). On the other hand, a positive shock to the financial technology (say lower banking fees or loan processing costs) leads to a lower degree of production specialization and lower net output for both of the alternative cases. The number of banks is lower (higher) for case II (III). As a consequence, the positive correlation between financial intermediation and real activities is possibly negative in the low- $N$  equilibrium, which explains the stage-dependent financial development observation. Finally, while a positive correlation between the financial intermediation ratio and the saving rate holds for all cases, the relationship between real output and saving may be negative (in the low- $N$  case and in the intermediate- $N$  case for  $N \in [(2\rho)^{-1}, (\rho(2-\alpha\rho))^{-1})$ ).<sup>28</sup>

These results are summarized by the following:

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<sup>28</sup> Again technology shocks have an ambiguous effect on savings. The ambiguity of savings responses arises for all equilibria because an increase in  $N$  has a negative effect on savings when  $N < [\rho(2-\alpha\rho)]^{-1}$  and a positive effect when  $N > [\rho(2-\alpha\rho)]^{-1}$ .

**Proposition 4.** (Characterization of Low- $N$  and Intermediate- $N$  Equilibria) *The steady-state properties of the low- $N$  and intermediate- $N$  equilibria differ from those of the high- $N$  equilibrium in the following aspects.*

- (i) *For both alternative equilibria, financial deepening, production specialization, and real output enhancement are negatively related with respect to production technology changes.*
- (ii) *For low- $N$  equilibrium, the degrees of competitiveness in the banking and intermediate goods sectors become positively related in response to production technology and financial intermediation costs disturbances.*
- (iii) *For both alternative equilibria, when financial intermediation costs or time preferences change, the level of real output and the saving rate may be negatively related.*

## VI. CONCLUDING REMARKS

We have constructed a dynamic general equilibrium model with technological frictions that arise when transforming savings into investment. The banking sector emerges endogenously to facilitate pooling of funds to overcome indivisibilities and to diversify borrower-specific risks. We depart from the previous literature by allowing both financial and real sectors to be monopolistically competitive in the sense of Chamberlin. We prove the existence of the steady-state equilibrium with a financially intermediated production process and examine how preference, technology, and setup and loan processing cost parameters affect the degree of financial deepening and product specialization, the saving rate, the loan-deposit interest spread, and the entry of intermediate goods and financial firms. We also show the possibility of multiple equilibria associated with different degrees of sophistication in the intermediate goods production process.

Our results suggest that, for a more developed economy, technological advances result in production specialization and financial deepening and discourage banking competition, whereas banking development that reduces the effective costs of financial intermediation narrows the interest rate spread, leading to

production specialization and financial deepening, encouraging banking competition and reducing the size of loans. For a less developed economy, some of the results will change, thus explaining why the correlation between financial and real activity varies across different stages of economic development, i.e., the “stage-dependent financial development” observation. Moreover, we find that, despite the positive correlation between the financial intermediation ratio and the saving rate in the less developed economy cases, real and financial activity may be negatively related. In fact, one of the provocative insights to come from this analysis is that economic development, financial deepening, and bank sector competitiveness are all non-monotonically related to one another, which generates testable empirical implications, in particular for understanding the role endogenous market structures played in financial and economic development and for providing plausible explanation of the “heterogeneous market structure” observation.

Finally, we note that the positive relationship between the financial intermediation ratio and the saving rate in the benchmark case need not hold in short-run transition to the steady state. Specifically, our comparative statics are derived around the steady-state equilibrium with financial intermediation in which the traditional sector vanishes. In the short run, an industrial transformation from the traditional to the modern sector accompanied by financial deepening would create a negative wealth effect on the rate of aggregate savings due to the presence of startup costs for intermediated production, which may offset the positive induced saving effect. For future work, it may be interesting to explore the underlying transitional dynamics to compare with observed financial sector evolving processes. To our knowledge, there are only two studies of transitional dynamics -- Greenwood and Jovanovic (1990) and Chen, Chiang and Wang (1996). However, neither consider market imperfections. Of course, in so doing, one must simplify greatly the structure of the model in order to produce any analytical results. Moreover, one may extend our framework to reexamine the welfare effects of monetary policy with an active banking sector. In particular, the degree of financial deepening and production specialization may now be sensitive to changes in the money growth rate and imposition of an interest rate ceiling.

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<b>Table 1</b> Comparative Static Results: High-N Equilibrium (Case I)						
	Setup Costs		Technology	Discount Factor	Intermediation Costs	
Effect on	$\Omega_0^x$	$\Omega^y$	$A^x$	$\beta$	$e_0$	$\mu$
$r^k - r^b$	0	0	0	-	+	+
$N$	0	-	+	+	-	-
$M$	+	?	-	-	+	+
$k^x$	0	?	?	+	-	-
$x$	0	?	+	+	-	-
$q$	0	?	-	-	+	+
Saving rate	0	?	?	+	-	-
Intermediated output	0	?	+	+	-	-

- Notes:** 1. Intermediated output is equal to  $Nx^\rho - \Omega^y$ ; the saving rate is measured by  $(1 - e_0)Nk^x / (Nx^\rho - \Omega^y)$ . Thus, the financial intermediation ratio  $Nk^x/y$  will be positively correlated with the saving rate.
2. The effects of changes in  $\Omega^b$  are simply the negative of the effects of changes in  $\Omega_0^x$ .
3. Case I corresponds to the “H” equilibrium in Figure 4a.

<b>Table 2a</b> Comparative Static Results: Low-N Equilibrium (Case II)						
	Setup Costs		Technology	Discount Factor	Intermediation Costs	
Effect on	$\Omega_0^x$	$\Omega^y$	$A^x$	$\beta$	$e_0$	$\mu$
$N$	0	+	-	-	+	+
$M$	+	?	-	-	+	+
$k^x$	0	?	?	+	-	-
Saving rate	0	?	?	+	-	-
Intermediated output	0	?	+	-	+	+

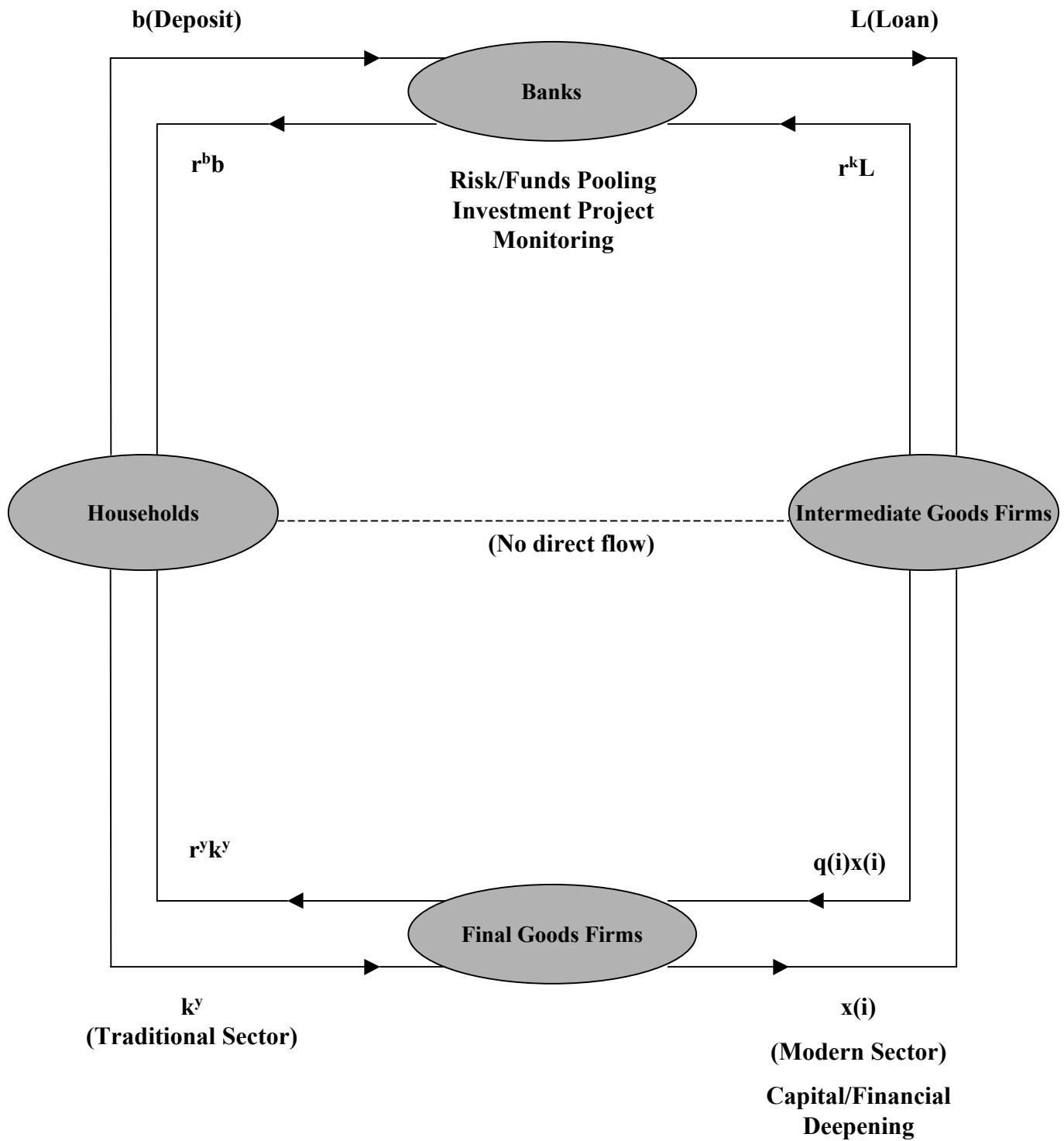
**Note:** Case II corresponds to the “L” equilibrium in Figure 4a.

<b>Table 2b</b> Comparative Static Results: Intermediate-N Equilibrium (Case III)						
	Setup Costs		Technology	Discount Factor	Intermediation Costs	
Effect on	$\Omega_0^x$	$\Omega^y$	$A^x$	$\beta$	$e_0$	$\mu$
$N$	0	+	-	-	+	+
$M$	+	?	+	+	-	-
$k^x$	0	+	-	+	-	-
Saving rate*	0	+	-	-(0)	?(-)	+(0)
Intermediated output	0	?	+	-	+	+

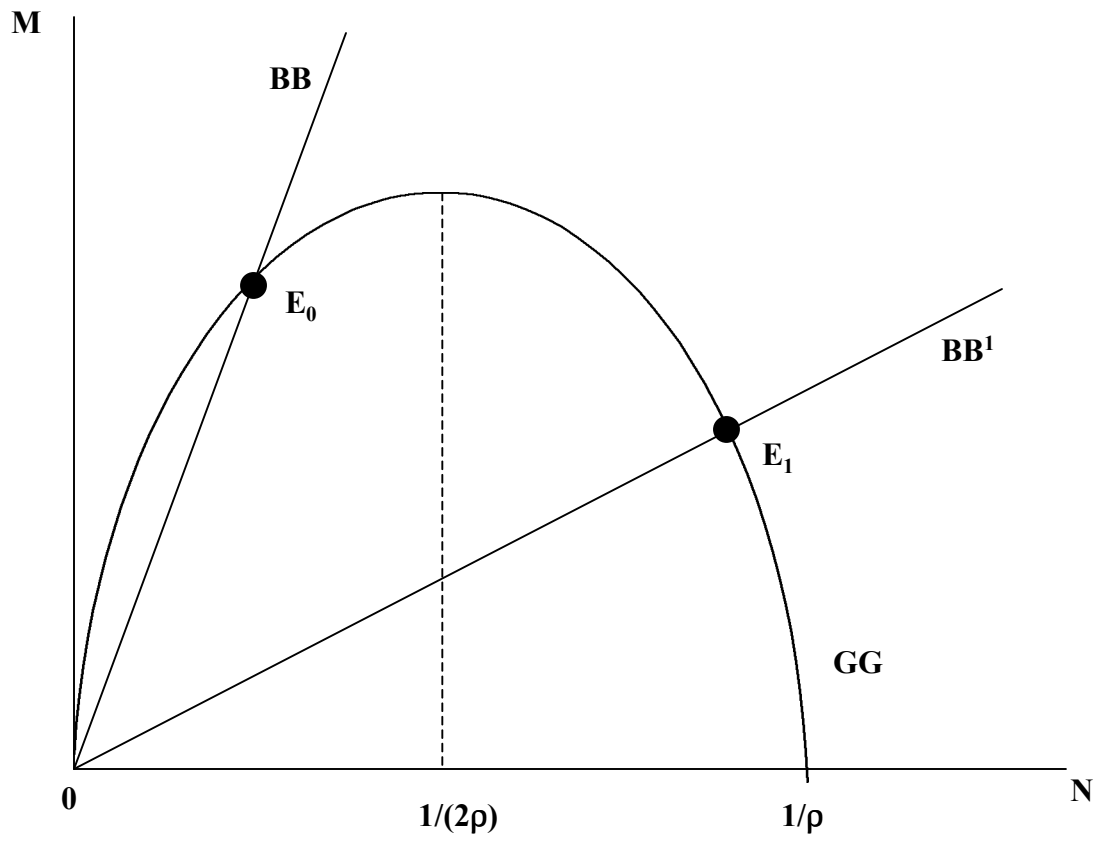
**Notes:** 1. Case III corresponds to the “I” equilibrium in Figure 4b.

2. A \* indicates that the result obtains for  $N \in ((\rho(2-\alpha\rho))^{-1}, (\rho(2-\rho))^{-1}]$ . Results in parentheses refer to the case  $N = (\rho(2-\alpha\rho))^{-1}$ . When  $N \in [(2\rho)^{-1}, (\rho(2-\alpha\rho))^{-1})$  the results are just like case I and II.

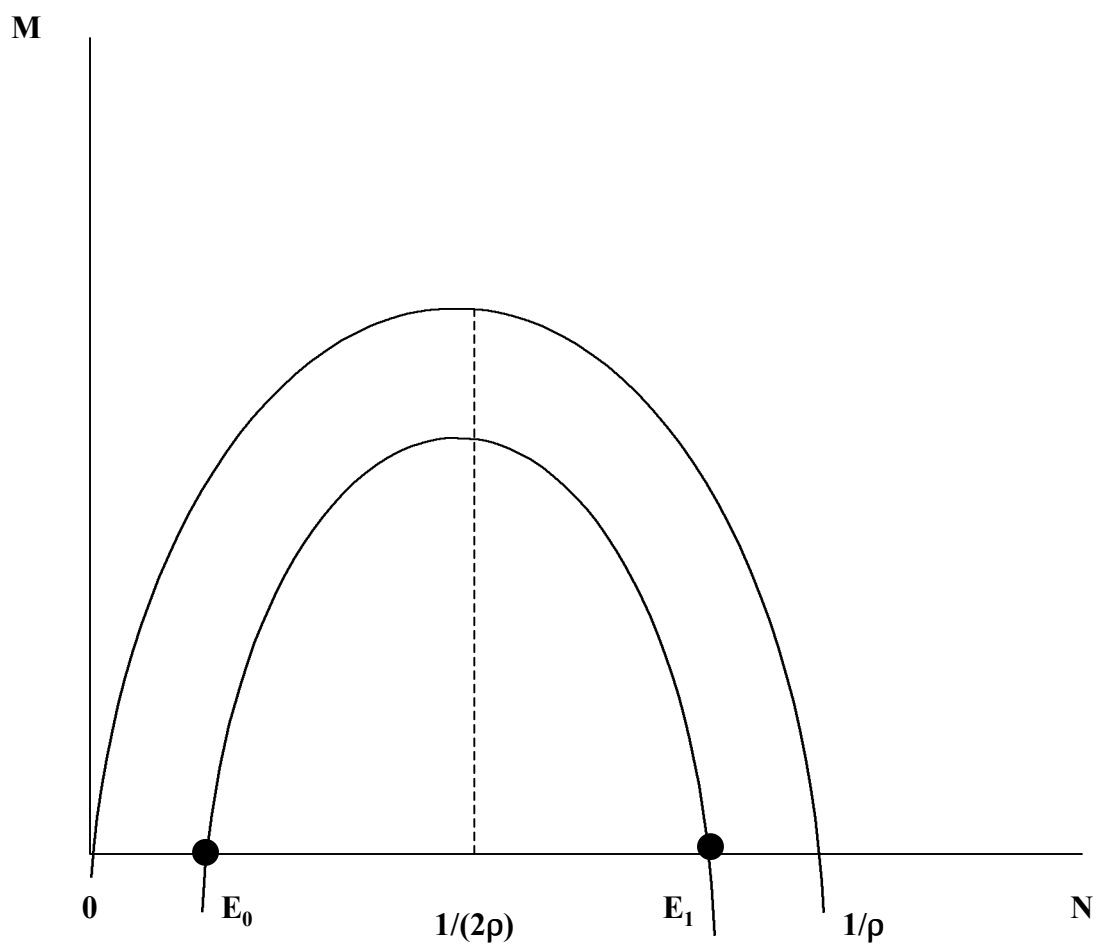
**Figure 1**  
**Description of the Basic**  
**Environment**



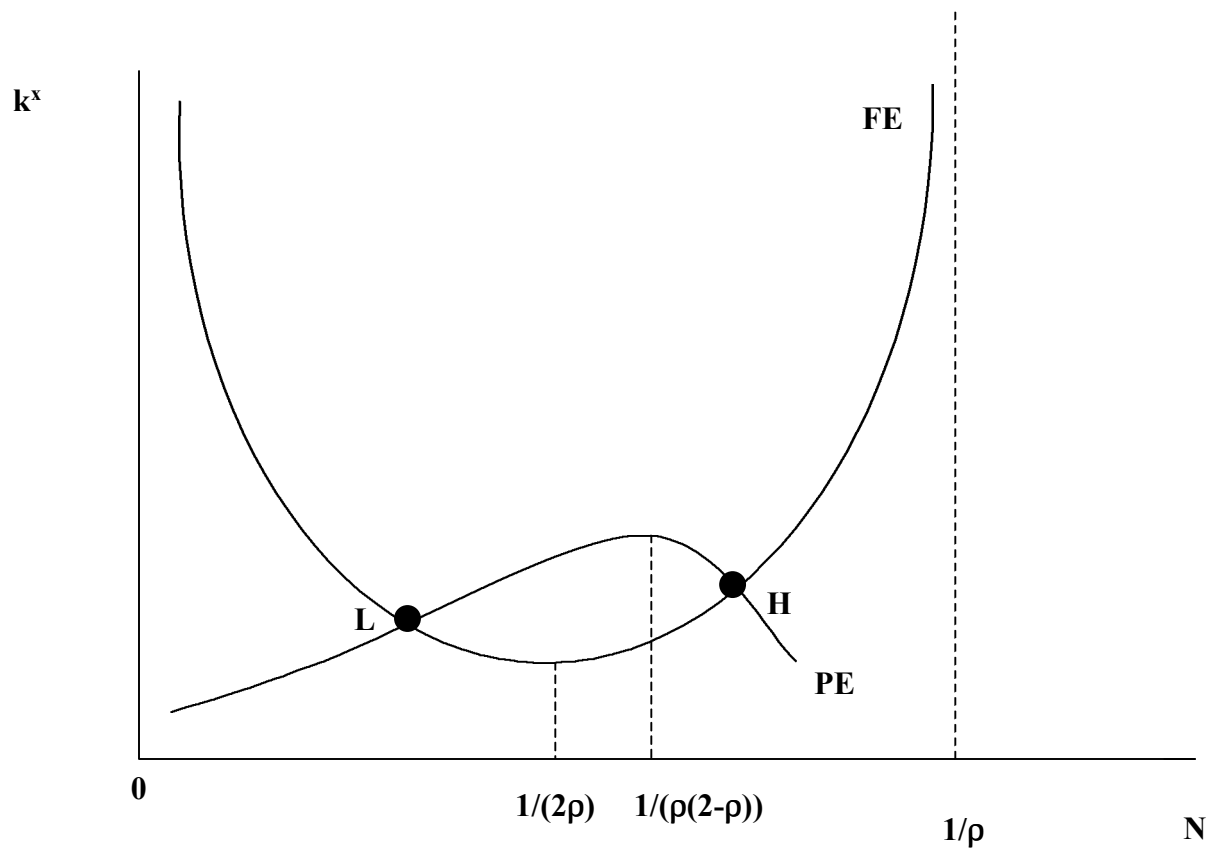
**Figure 2**



**Figure 3**



**Figure 4a**  
**Diagrammatic Analysis of Steady-State Equilibria**  
**(Cases I and II)**



**Figure 4b**  
**Diagrammatic Analysis of Steady-State Equilibria**  
**(Case III)**

